HEINE

Longitudinal-Drum

BOILERS

H-TYPE

HC-TYPE

HEINE
Longitudinal-Drum
BOILERS

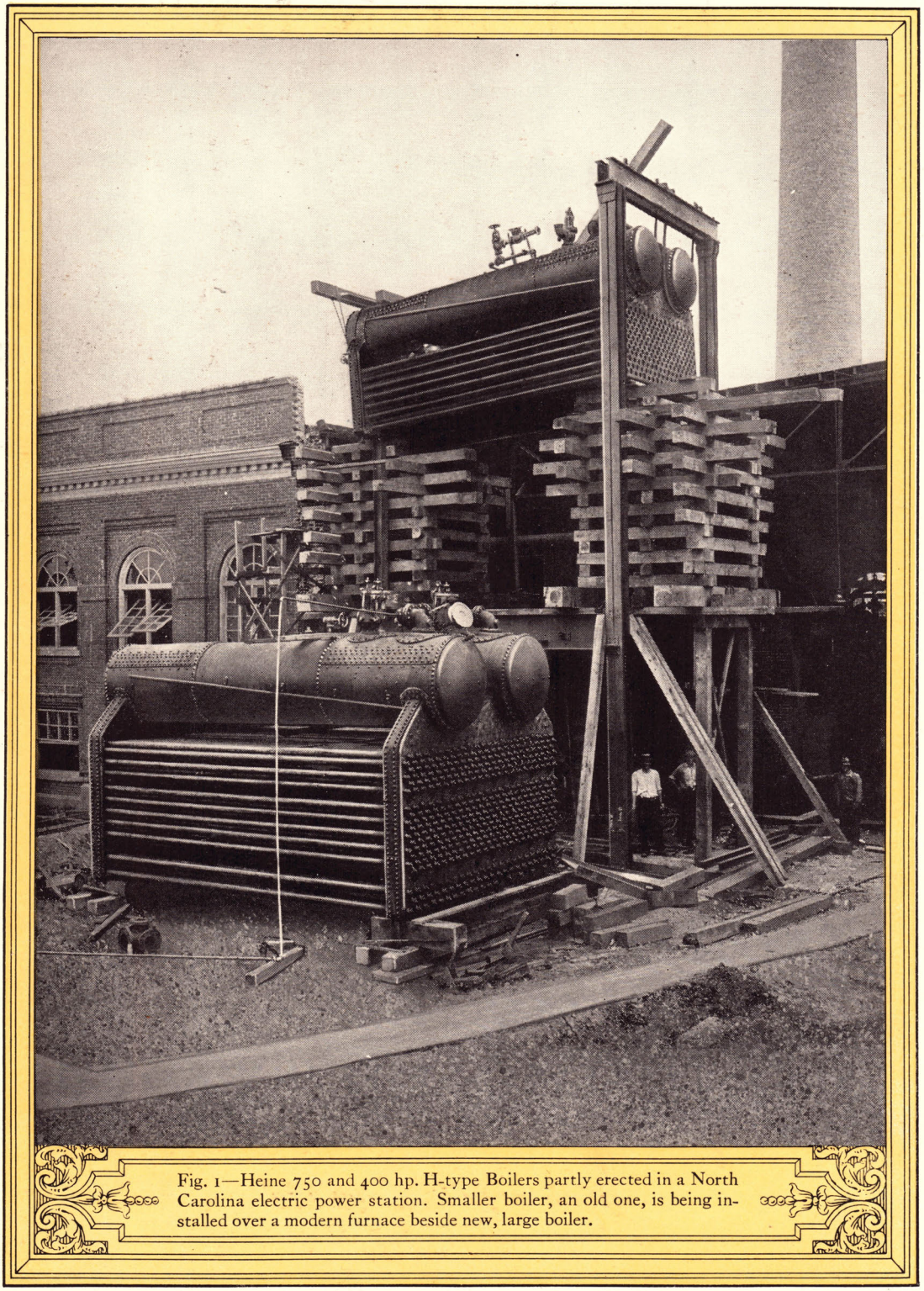

Fig. 1—Heine 750 and 400 hp. H-type Boilers partly erected in a North Carolina electric power station. Smaller boiler, an old one, is being installed over a modern furnace beside new, large boiler.

HEINE
Longitudinal-Drum
BOILERS

H-TYPE
Horizontally Baffled
HC-TYPE
Cross Baffled

Bulletin
No. 52

1924

Heine Boiler Company
Incorporated
Saint Louis, U.S.A.

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FOREWORD

IN the forty-two years we have been building water-tube boilers we have acquired and maintained a reputation for superior construction. By proper choice of materials and plate thicknesses and by liberal use of both labor and material on our riveted joints and connections, we greatly prolong the life of our boilers. Furthermore, in certain instances by changing tubes, our boilers have been approved, years after they were put into service, for pressures higher than they carried originally.

Our first boiler was built in 1882 and ran in continuous service for thirty-four years. Afterward it was repurchased by us and set up at our Saint Louis shop as an exhibit. It is interesting to note that a boiler insurance company has approved this boiler for operation today at the same pressure for which it was designed forty-two years ago. This is only one of many examples of remarkable durability under service conditions, which have demonstrated the effectiveness of our methods of boiler construction.

All Heine Boilers are built in either of two shops, one located in Saint Louis, Mo. and the other in Phoenixville, Pa. These shops are completely equipped for production of accurate work on a manufacturing scale. Many of the operations performed in our shops are of such a special nature that we have designed, built and patented machinery for our own use. As an indication of our policy of keeping up the standards, in order to meet the constantly growing demand for boilers of higher pressure and larger size, we have recently added to our plant two additional buildings, equipped with cranes, drills, presses, and other modern machinery for heavy work, including a set of pyramid bending rolls which the makers tell us are the largest ever built.

As pioneers in the water-tube boiler field we have kept our place among the leaders in the industry by anticipating the requirements of power-plant engi-

neers. We have three standardized types of boilers which are built in sizes to cover the complete range of horsepower and pressure demanded by present-day practice.

Heine Long-Drum Boilers—This type of boiler when equipped with horizontal baffles is denoted as the H-type and when equipped with cross baffles, as the HC-type.

Heine Cross-Drum Boilers—This type of boiler when equipped with horizontal baffles is denoted as the M-type, and when equipped with cross baffles as the MC-type.

Heine Bent-Tube Boilers—This boiler is built in a wide range of sizes, all of which are covered by the designation V-type.

These various boilers are each described in separate bulletins, any one or all of which we shall gladly send upon request.

From the beginning, Heine Boilers have been built to serve and we have always recognized a responsibility for the performance of our product. To serve our customers we have continually enlarged the personnel and facilities of our engineering, field service and sales departments, and today we can render the power-plant industry better service than ever before.

We are furnishing the very best designs, materials and workmanship that modern engineering skill can produce, and try to help our customers to maintain the highest standards of performance. For, in this way only can we hope that our business will continue to grow and to prosper.

Heine Boiler Company

HEINE BOILER NO. 1

HEINE *Longitudinal-Drum* BOILERS

THE Heine Boiler Company is a pioneer in the water-tube boiler field. The first Heine water-tube boiler was built by the Company in St. Louis in 1882. The patents covering this design were granted to Herman Heine in 1878 and 1880 and assigned exclusively to the Heine Boiler Company. During the forty-two years that this boiler has been manufactured it has been installed and used successfully in every type of industry and plant in all parts of the world.

Heine Long-Drum Boilers may be arranged for the widely used horizontal baffling, or for cross baffling when so desired. The boilers with horizontal baffling are designated "Heine H-type Boilers"; while those with cross baffling are designated "Heine HC-type Boilers".

GENERAL DESIGN

BOILERS of this type are made up of waterlegs connected by tubes and drums parallel to the tubes in such a way that the tube bank contains practically the entire heating surface of the boiler. There may be more than one steam and water drum depending upon the size of the boiler. The drums are riveted to the flanges of the throat openings in the waterlegs. The general arrangement is clearly shown in Fig. 2. The tube bank has a slope of one in twelve to the horizontal. The high end is almost always the firing end, although for very special cases this may be reversed. The exact arrangement of the baffling depends upon the furnace and other conditions.

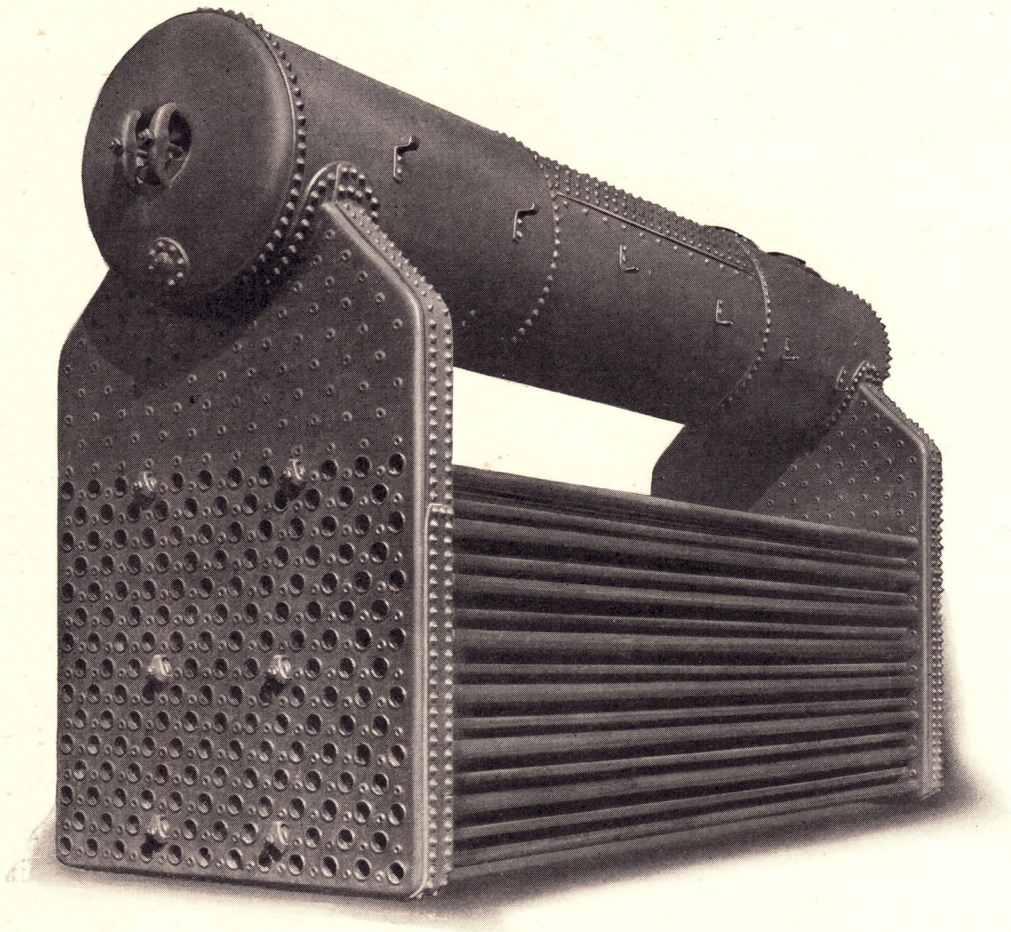

Fig. 2—Heine HC-type Boiler, designed for use with superheater above tube bank.

Details of Construction

THE waterlegs of the Heine Long-Drum Boilers are made up of two heavy steel plates with long radius turned flanges all around. The tube and handhole sheets are joined by a wrapper strap riveted to the inwardly turned flanges. This construction keeps all rivet heads out of the fire and gases.

The flat surfaces of the waterleg plates are stayed against internal pressure by means of hollow staybolts screwed into accurately threaded holes, the projecting ends being riveted over to give additional holding power and tightness. These staybolts are made from heavy-wall seamless tubing which is exceedingly ductile and tough, and with a tensile strength greater than is actually required to carry the stresses to which they are subjected. The hollow feature makes it possible to use a special patented upsetting tool of our own design, which sets the metal of the bolt solidly against the plate besides giving an exceedingly neat and workmanlike finish. These openings are utilized also as a means of access to the gas passages for the purpose of keeping the heating surface free from accumulations of soot and dust. An opening at the top of the front waterleg is provided for the lower water column connection. One or more forged pads are riveted to the bottom of the rear waterleg for drain connections. The nipple connection is so designed that the drain connection is horizontal and therefore is readily attached to the blowdown piping.

The drums may be 36, 42, or 48 inches in diameter depending upon the number of drums and size of the boiler. The longitudinal seams are of double-strap butt-joint construction. The heads are dished to a radius equal to the diameter of the shell, therefore they require no internal staying. They are of sufficient thickness to obviate all danger of cracking due to breathing under pressure variations. The rear heads are provided with manholes closed by pressed steel covers. The drums carry the steam outlet and safety valve saddles, which are of heavy forged steel with flanges large enough for a double row of rivets. This is shown in Fig. 3. To the drums and drumheads are also attached forged steel pads for the feed and blowoff connections.

The shells are riveted to the flanges of the throat opening in the waterlegs. The corresponding openings in the shell are entirely cut away and reinforced with specially forged throat stays so that practically the full throat openings are available for unrestricted circulation. The rivets grip through the three thicknesses of throat stay, shell and waterleg flange as shown in Fig. 9.

All the material, workmanship, and design are in accordance with or better than the A.S.M.E. Boiler Construction Code requirements. For example: nothing but fire-box quality of plate is used throughout, although the Code permits flange quality in many places; the thickness of the drumheads is greater than the rules require; and solid forged pads are used for threaded openings instead of reinforcing the opening in the shell plate with a small piece of plate.

Several forms of handhole closures are used, all being of such a nature that the pressure tends to tighten them. The most generally acceptable one is cast iron or pressed steel plate with nut, bolt, and yoke on the outside, the steam tight joint being made by means of a gasket. The Key handhole cap may also

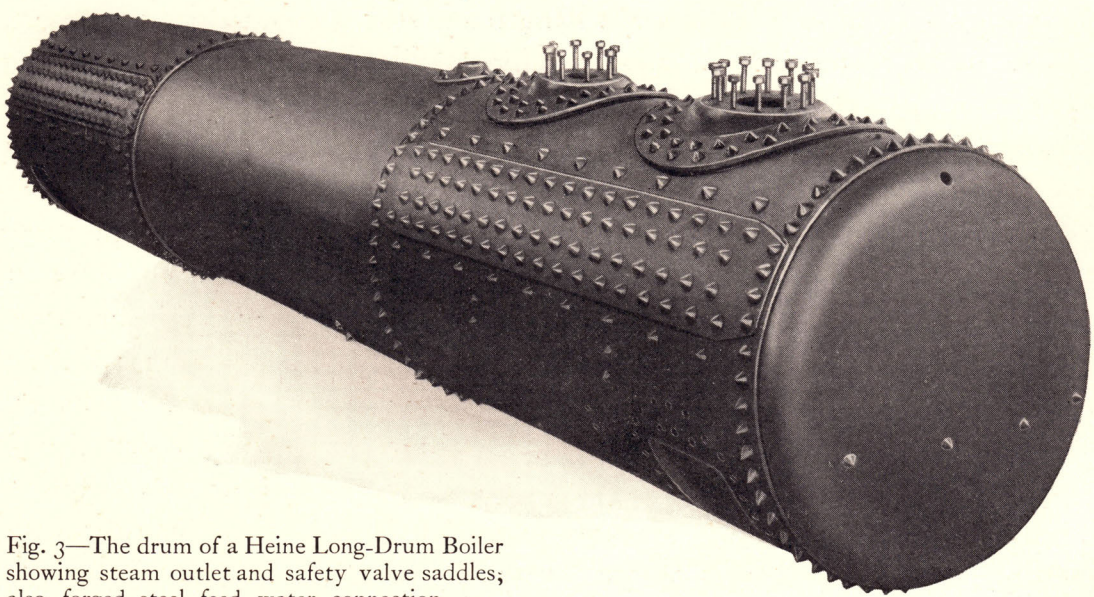

Fig. 3—The drum of a Heine Long-Drum Boiler showing steam outlet and safety valve saddles; also forged steel feed water connection.

be used, this being a device that requires no gaskets. The three types are shown in Fig. 4.

The boiler in the smaller sizes for hand firing is usually supported in front on cast iron tee section columns which are a part of the firing front. The rear of the boiler rests on rollers supported by a structural steel backstand. The larger size boilers and also those having stoker settings are always supported in front by steel overhead supports. The connection between the supporting structure and the boiler is a U loop passing under that part of the drum which projects beyond the waterleg. See Fig. 5. The rear of the boiler may be supported in the same manner. Thus no part of the weight of the boiler is ever carried by the brickwork of the setting.

A drying pan with holes in the sides and bottom is attached inside the drum at the steam outlet. There is also a deflection plate over the front waterleg throat opening which directs the steam and water circulation. Towards the rear and at the bottom of the drum is located a feedwater heater and purifier as shown in Fig. 9. The water column connections are made at the top of the front head and at the top of the front waterleg. The column itself is located in a position to suit best the layout of the plant.

A steel plate upper front properly flanged and stiffened and with doors giving access to the waterlegs is standard equipment. For hand firing a lower front with the usual fire and ash pit doors, dead plates, jambs and arches, grates and bearing bars is regular equipment. For stoker fired installations the fire front is omitted to a point ordinarily 6 ft. above the floor line, thus providing for the application of any type of furnace which it may be desired to use. The steel plate upper and cast-iron lower hand fired type fire fronts are shown in Fig. 6.

The boiler setting may be made as high as the fuel and furnace conditions require. When erected ready for service the boilers are enclosed in whatever kind of setting may be preferred, this usually being the ordinary refractory-lined brickwork which extends in height to above the middle of the drums. Cast iron cover plates support a brick deck extending from the side walls to the drum and also between the drums in multidrum boilers. At the rear of the setting, the walls and a cross wall over the drums are run up to form the burned gas uptake.

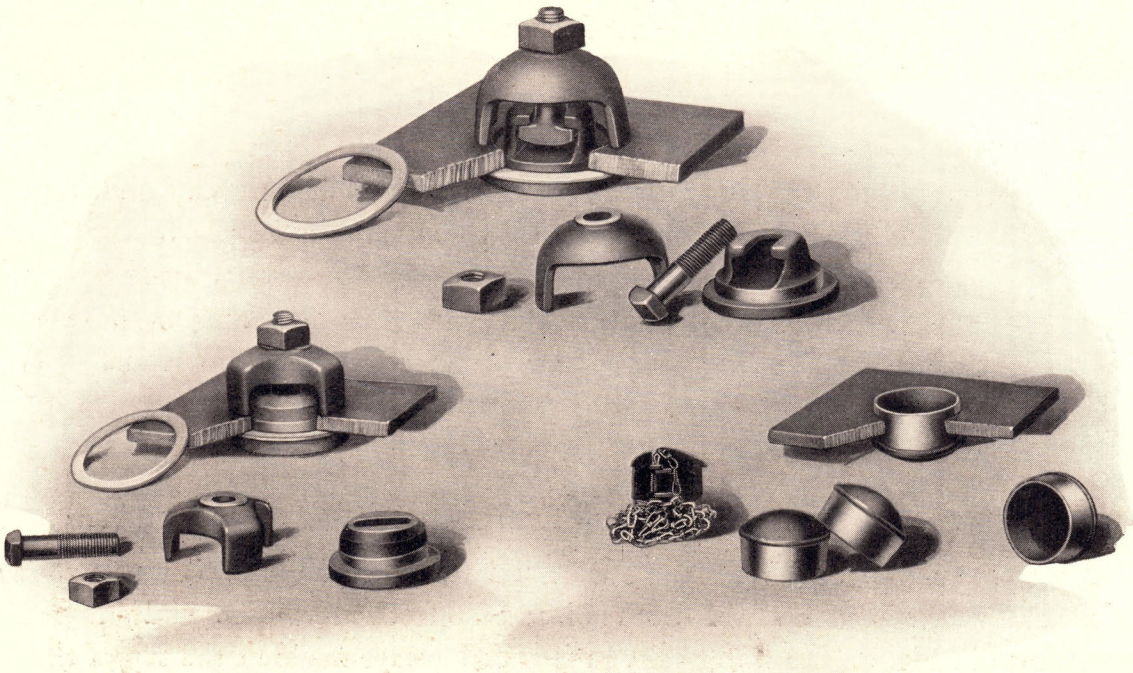

Fig. 4—The handhole closures for the openings in the waterlegs opposite the tube ends may be of cast iron or forged steel with gaskets, or of the Key type which uses no gaskets. They are arranged from left to right in the order mentioned.

Special steel encased settings have been developed for such requirements as dredge boat settings where the boiler must be securely braced and at the same time the dead weight must be kept as low as possible. Steel encased jobs for high draft or other requirements are regularly adapted to the Heine Long-Drum Boiler.

The foregoing description applies to either the longitudinally baffled H-type boilers or cross baffled HC-type boilers. The only difference in the construction of the two types is that in the former the tubes are nested more closely together than in the latter.

CIRCULATION

THE normal water line is 2 inches above the center line of the shell at its midpoint. The feedwater is introduced into the boiler through the feed connection on top of the shell which discharges into the special water purifying device shown in Fig. 9. This device not only deposits suspended and precipitated solids, but it also brings the temperature of the feedwater up to that of the main water body before discharging it at the open end. The blowoff connection is made to the opposite end of this purifier for blowing off the precipitated impurities.

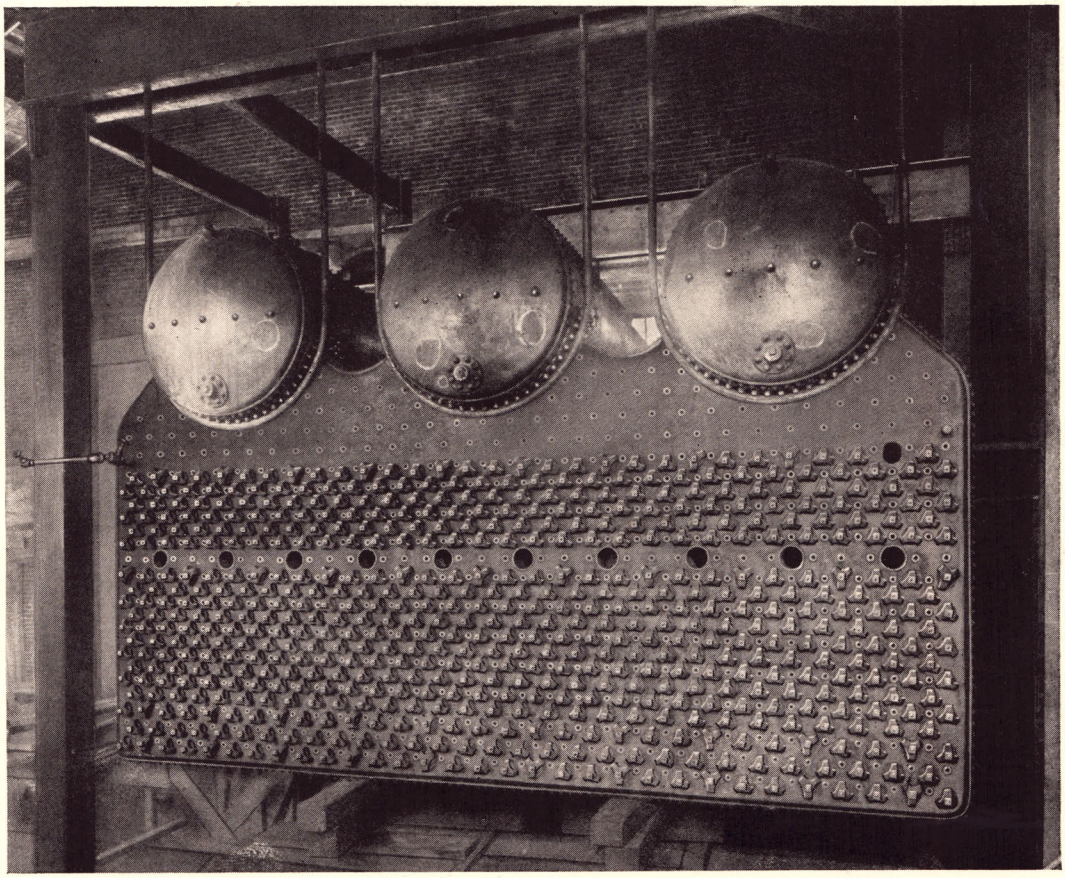

Fig. 5—One of five 1000 hp. H-type boilers partly erected in a large paper mill.

The water descends through the throat opening in the rear waterleg, thence through the tube bank where the steam is formed. The mixture of steam and water rises into the higher boxheader where it passes to the drum through the front throat opening. This mixture of steam and water strikes the deflection plate, the water being directed down towards the rear of the drum, the steam continuing on into the steam outlet.

Fig. 6---A typical steel plate upper front and cast-iron lower fronts for hand firing operation on a Heine Longitudinal Single-Drum Boiler.

Furnace Arrangement

THE discussion of furnace and combustion conditions will be divided in two parts, (a) pertaining to the H-type boiler, (b) to the HC-type boiler. Any type of grate or stoker may be applied to these boilers and they may also be adapted to the use of waste-heat, powdered-fuel, oil, gas or any other fuel. The description of the operation for coal burning only will be given, but the principles involved are the same for other fuels.

(a) *Heine H-type Boilers* are provided with longitudinal baffles. These may be arranged in a great variety of ways, and care is always taken to proportion the areas of the gas passages to the kind of fuel to be used, the probable capacity at which the boiler will run, draft available, etc.

For low capacity and hand firing with natural draft in the smaller sizes, the single pass arrangement is ordinarily used. See Fig. 9. This consists of one baffle on the lower, second, or third row of tubes as may be desired, with an opening at the back and another baffle

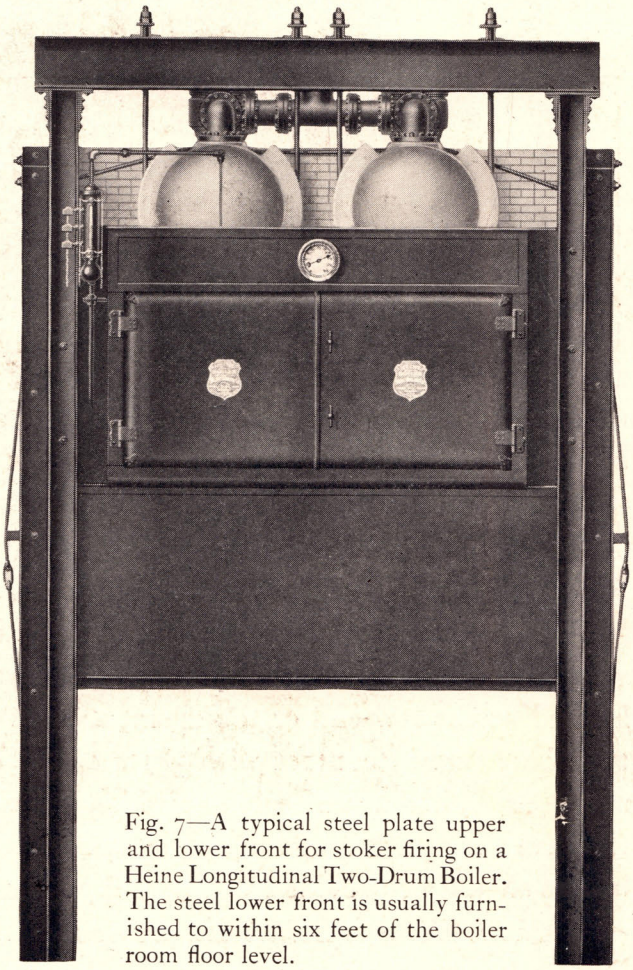

Fig. 7—A typical steel plate upper and lower front for stoker firing on a Heine Longitudinal Two-Drum Boiler. The steel lower front is usually furnished to within six feet of the boiler room floor level.

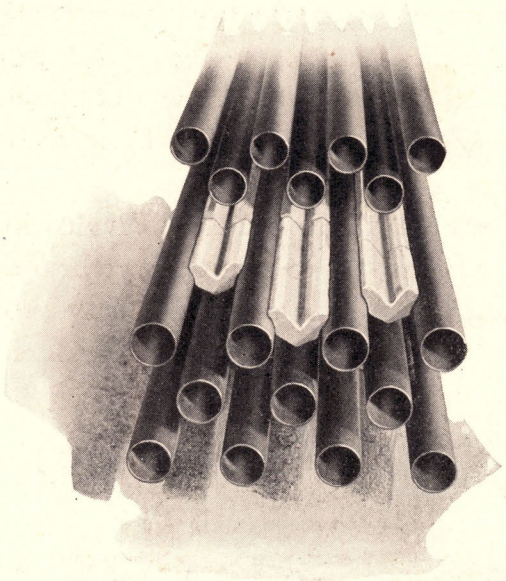

Fig. 8—Heine H-type Boilers are designed to use patented B-type baffle tile. These are of such size and shape that they can be removed or replaced at any time without disturbing the tubes or dismantling the boiler.

on the top row of tubes with the opening at the front. In large sizes with high capacity furnaces a middle baffle somewhat more than half way up the tube bank is introduced giving a double pass of the gases through the tube bank. When arranged for a middle baffle, a row of 5 in. access tubes is introduced in both the front and rear waterlegs through which the baffle tile may be introduced and adjusted. This three baffle arrangement is shown in Fig. 16. The most usual arrangement for the lower baffle is on the third row of tubes with the opening at the back, however the baffles are easily changed to suit changing conditions. The method of arrangement is shown in Fig. 8. This exposes the entire length of the three lower rows of tubes so that the maximum absorption of radiant heat may be obtained while at the same time some absorption of heat results from the actual contact of hot gases. A bridge wall suited to the type of furnace or grate should always be provided.

The gases of combustion then pass into the tube bank through the opening back of the lower baffle and come forward parallel to the tubes. Where a middle baffle is used they turn up through the opening in front of this, thence backward along the tubes to the opening at the rear of the top baffle. The uptake is located at the low end of the drum, so that the gases after leaving the main tube bank are in contact with parts of the drums, thus tending to generate more steam, and superheat that which is already made, and turn up between the drum into the breeching. The uptake located just above the top of the boilers should be provided with a damper by which to regulate the fire.

(b) *Heine HC-type Boilers* are provided with cross baffles which may also be arranged in various ways. Heretofore the most generally used plan has been to

have the bridge wall extend clear up to the tube bank, the front baffle rising from just above the bridge wall to the upper tubes. This may be at right angles to the tubes or inclined towards the front so as to give a decreasing area to the gas passage as shown in Fig. 17, the reduction being proportioned to the decrease in gas temperature due to the heat absorption. The second baffle is located nearer the back end of the boiler than it is to the front baffle, and with the arrangement under consideration, ordinarily extends the full height of the tube bank so that the gases after passing through the second pass turn entirely beneath the tubes and rise into the third pass, and thence into the space beneath

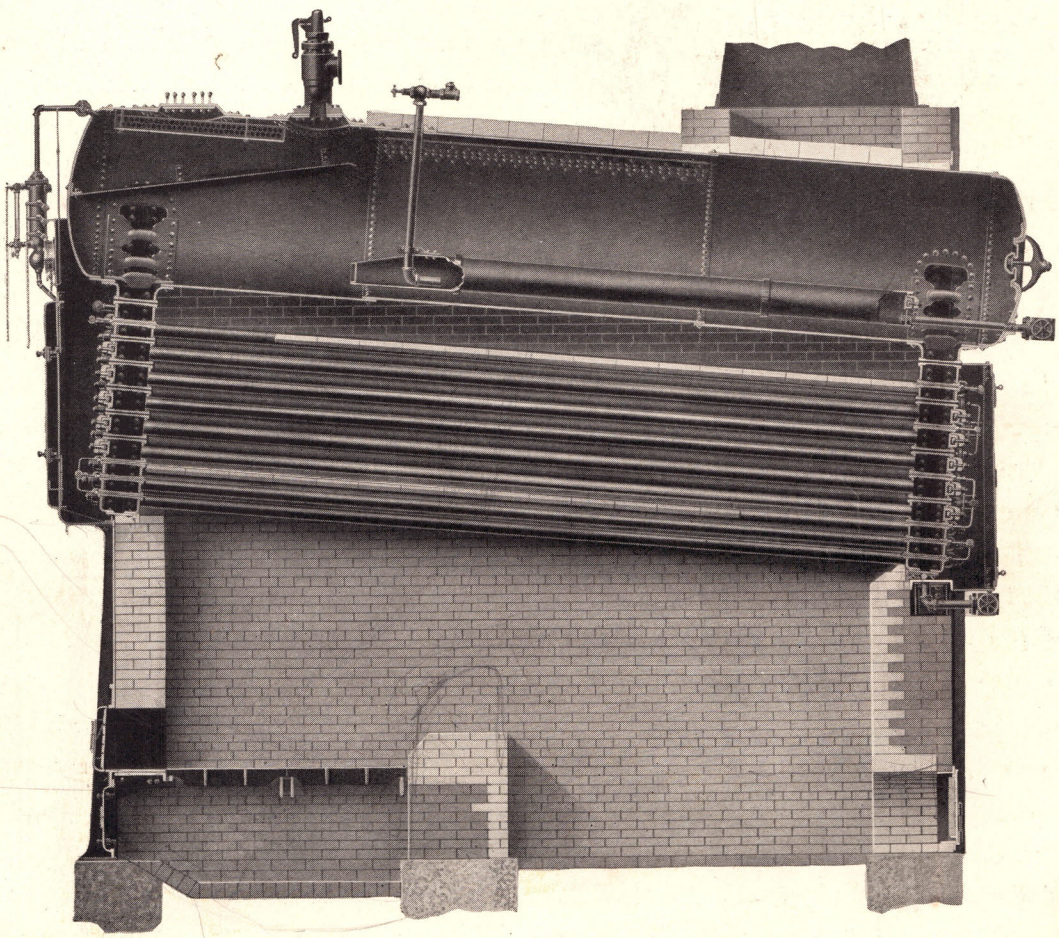

Fig. 9—Typical two baffle Heine H-type Boiler arranged for hand firing.

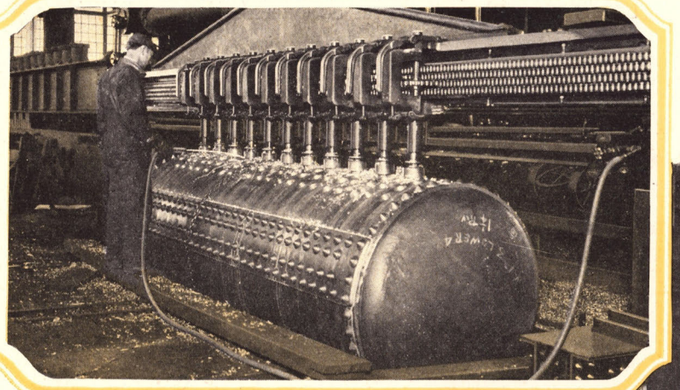

Fig. 10—The tube holes in all Heine Boilers are bored by machine, which assures accurate diameter and true location of every hole.

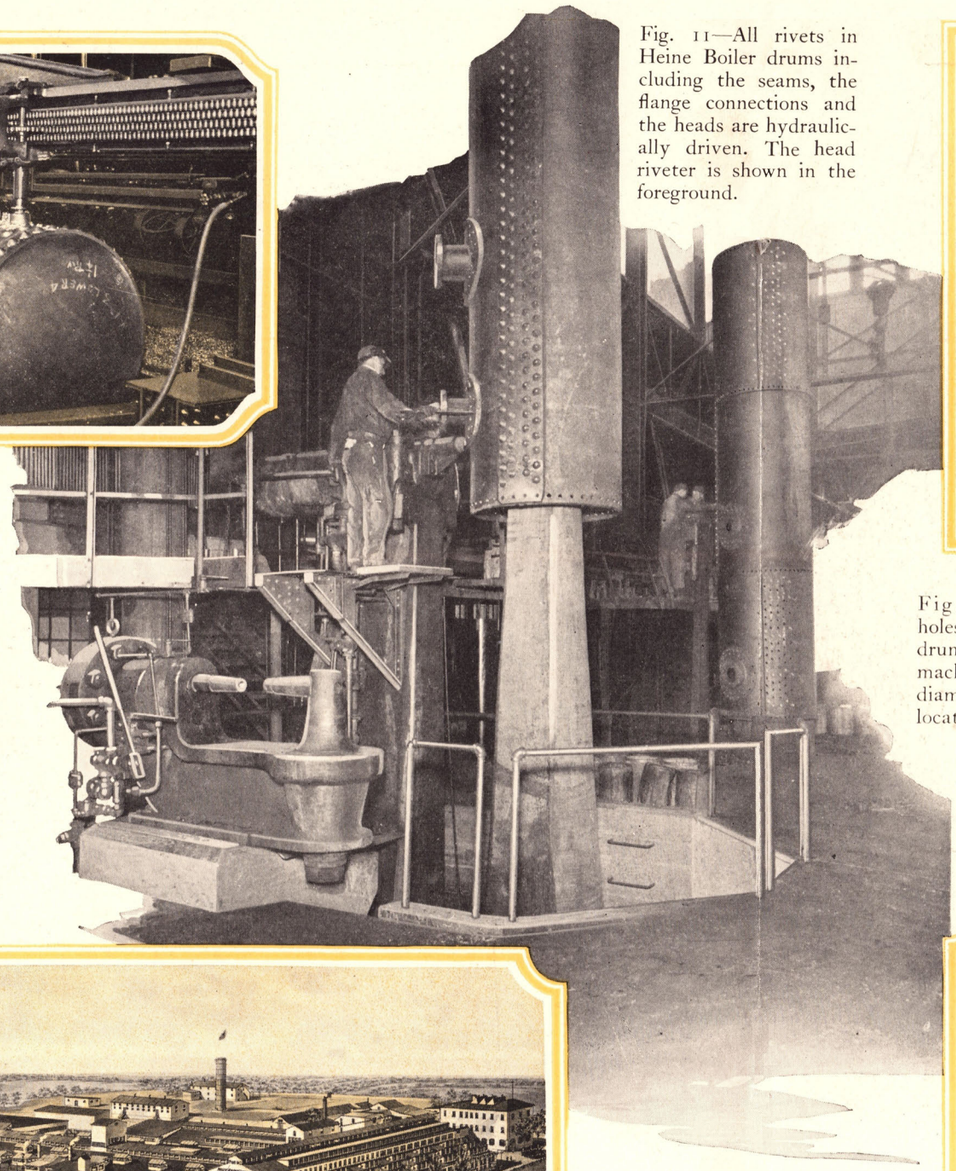

Fig. 11—All rivets in Heine Boiler drums including the seams, the flange connections and the heads are hydraulically driven. The head riveter is shown in the foreground.

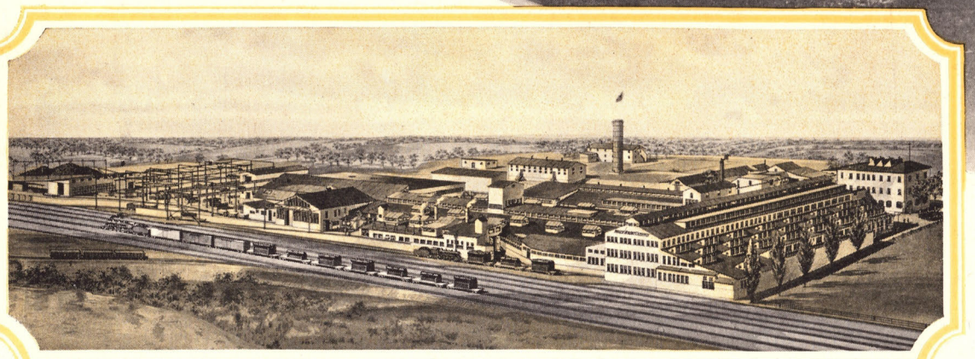

Fig. 12—Plant No. 2, Phoenixville, Pa.

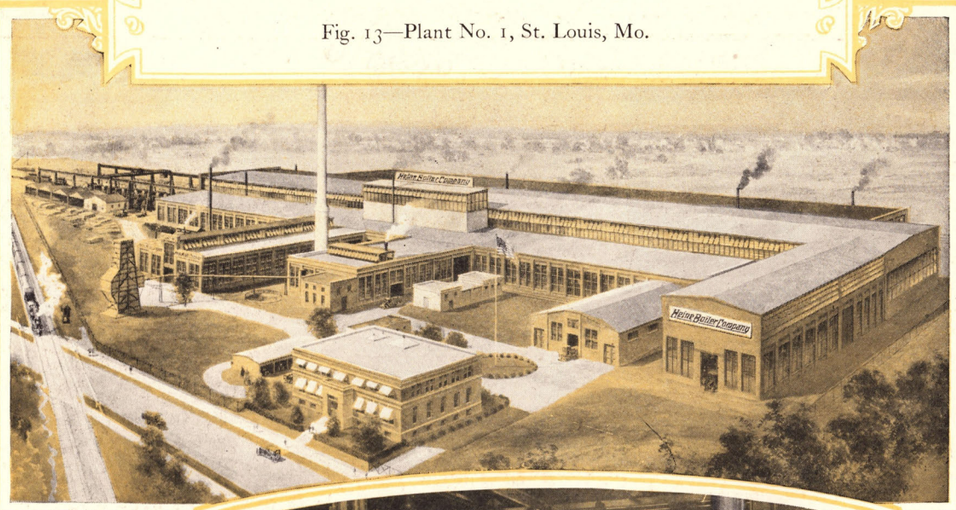

Fig. 13—Plant No. 1, St. Louis, Mo.

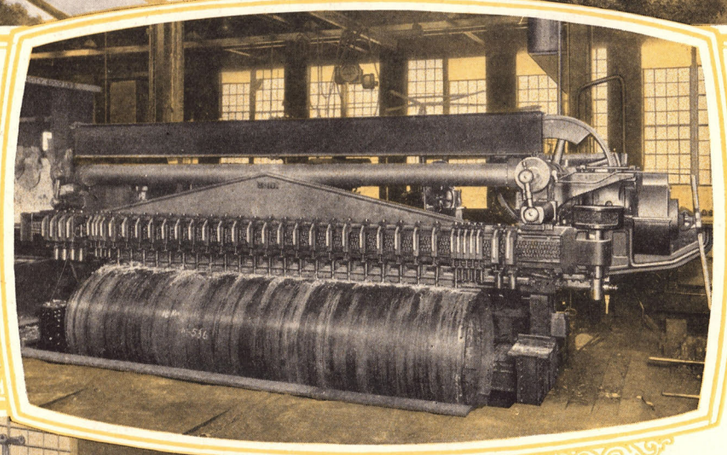

Fig. 14—All rivet holes in Heine Boiler drums are drilled by machine to accurate diameter, and in true location and direction.

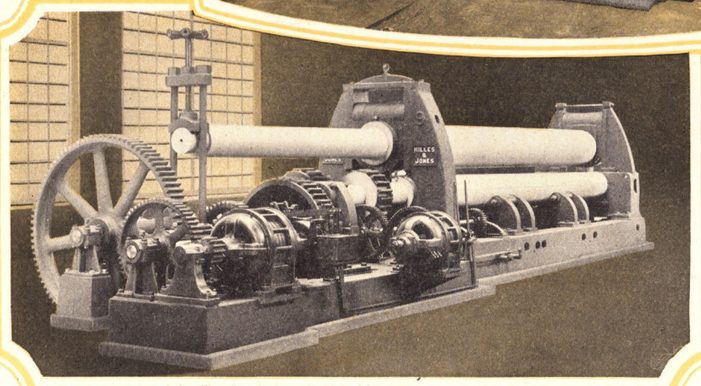

Fig. 15 — This set of pyramid rolls—largest ever built—permits Heine Boilers to be constructed in sizes and plate thicknesses called for by the most recent demands for high pressure and large capacity.

Manufacturing facilities of the Heine Boiler Company are embodied in two modern boiler shops, one in St. Louis, Mo. and the other in Phoenixville, Pa. These shops are equipped with special machinery, much of which was designed by Heine engineers, to insure accurate workmanship on a manufacturing scale.

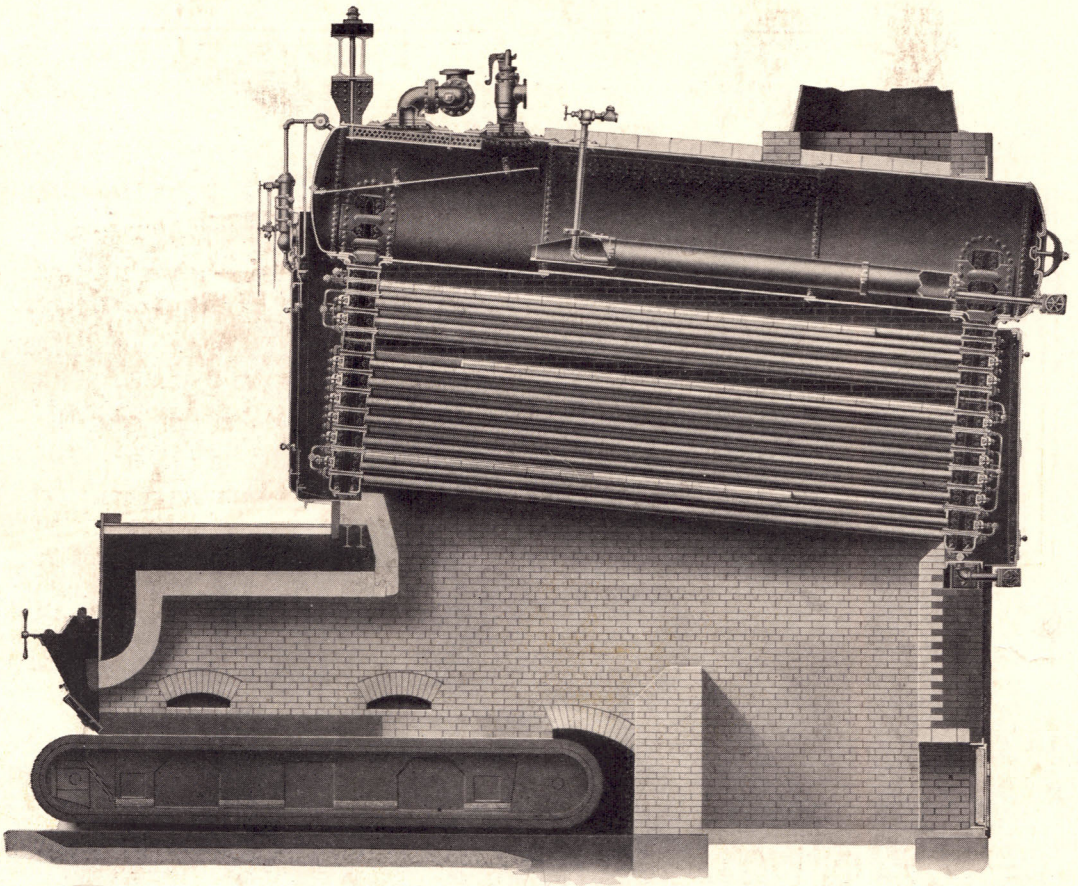

Fig. 16—Typical three baffle Heine H-type Boiler arranged for chain grate stoker.

and between the drums. A partition or curtain baffle extends from the boiler drums to the top of the second baffle. The uptake being located between this partition and the end of the setting, the gases on leaving the tube bank rise between the drums into the uptake. There is thus provided opportunity for slightly superheating the steam that is already made and the formation of a little more steam in the drums. The uptake should be provided with a damper above or between the drums for the proper control of the fire.

Another and more preferable arrangement of the furnace is to use a low bridge wall and make use of the entire combustion chamber as in the case of the H-type boiler. See Fig. 18. With this arrangement a longitudinal baffle is placed on the bottom, second, third, or higher row of tubes, extending approxi-

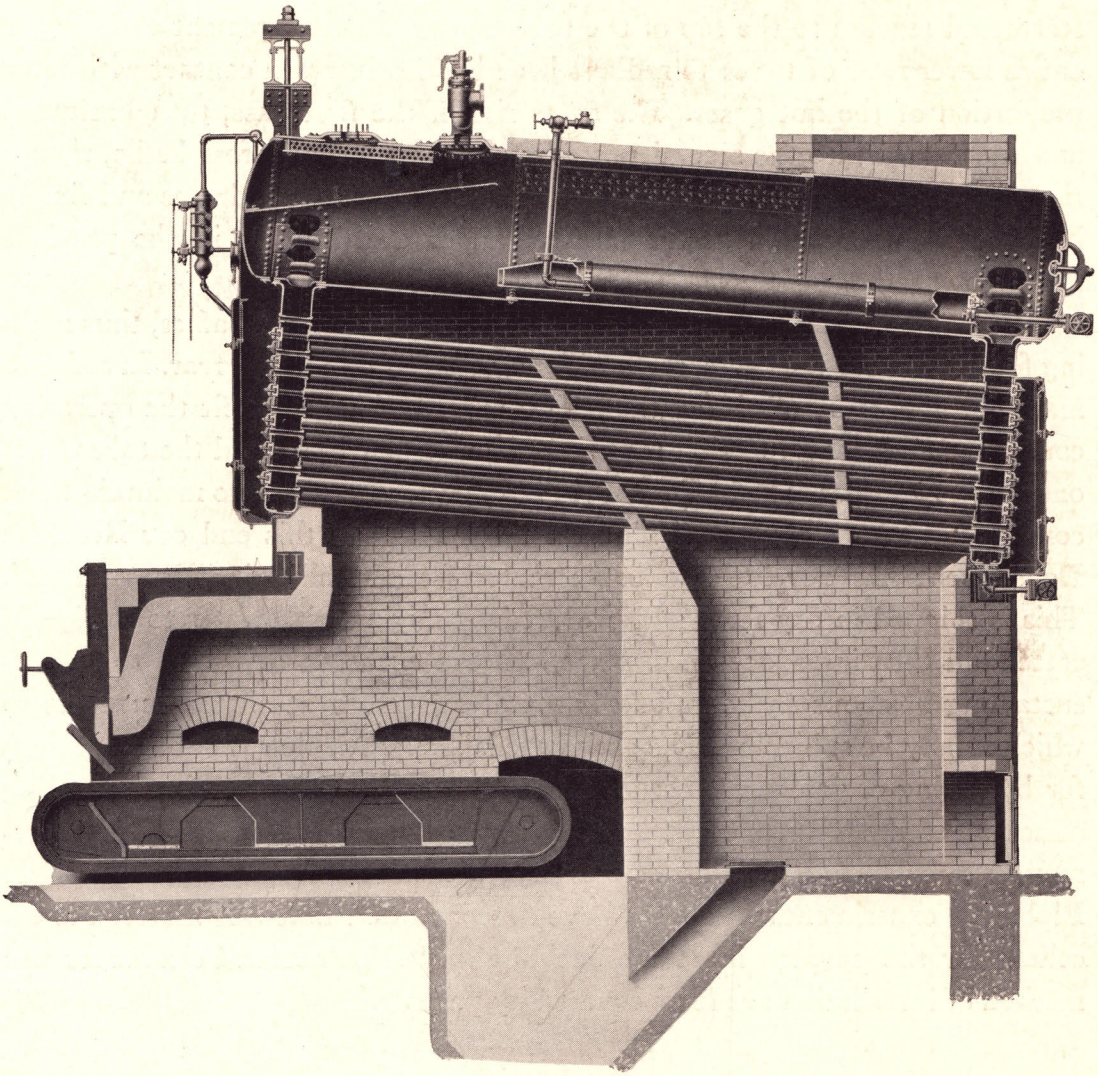

Fig. 17—Heine HC-type Boiler arranged with high bridge wall and second baffle so placed as to force all gases clear below the tube bank.

mately half way or a little more of the length, from which point the cross baffle starts and reaches to the top of the tube bank. The arrangement exposes the entire lower rows of tubes to radiant heat besides being in contact with some proportion of the hot gases. The gases rise in the first pass, turn backward and downward into the second pass, flow under the short cross baffle, thence rise again through the third pass into the space beneath the drums and finally into the uptake located at the farther end of the drum as in the previous arrangement.

Cross baffling may be further modified by supplying three baffles, thus making four passes for the gases, the outlet being below and at the rear. In order to maintain maximum efficiency the baffles must be located to fit the operating conditions and it is important that there be no leakages around the tubes from one pass to another. The baffles should be of such a nature as to maintain these conditions under stress of all kinds of service and to this end our Research Department has developed a baffle material and called it "REFRACTITE". This is shipped in dry form and prepared by mixing with water to semi-fluid state, and then introduced into place between forms. It sets so as to be self-sustaining in about 24 hours and is a true refractory at all temperatures to which it may be subjected. The shrinkage is inappreciable so that no openings for bypassing of gases ever occur. Special means are provided for preventing adhesion of the "REFRACTITE" to the tubes, thus making it possible to remove a tube should it become necessary, without damaging the baffle itself. Elaborate experiments and trials have demonstrated that this material is excellent for the purpose intended. See Fig. 19. "REFRACTITE" clearances and method of installation are fully covered by patents.

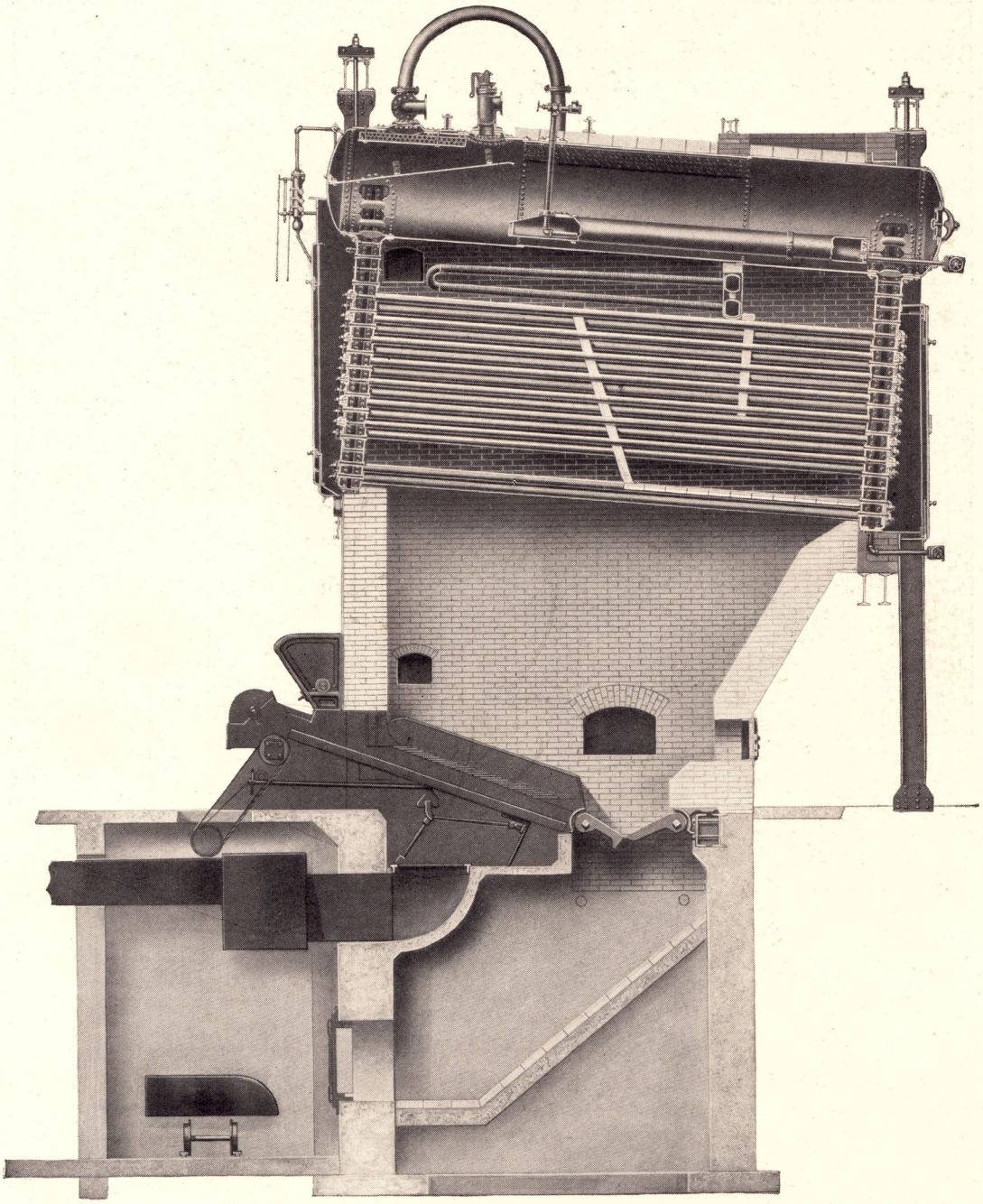

Fig. 18—Heine HC-type Boiler with superheater above the tube bank. One of four boilers in Municipal electric power station.

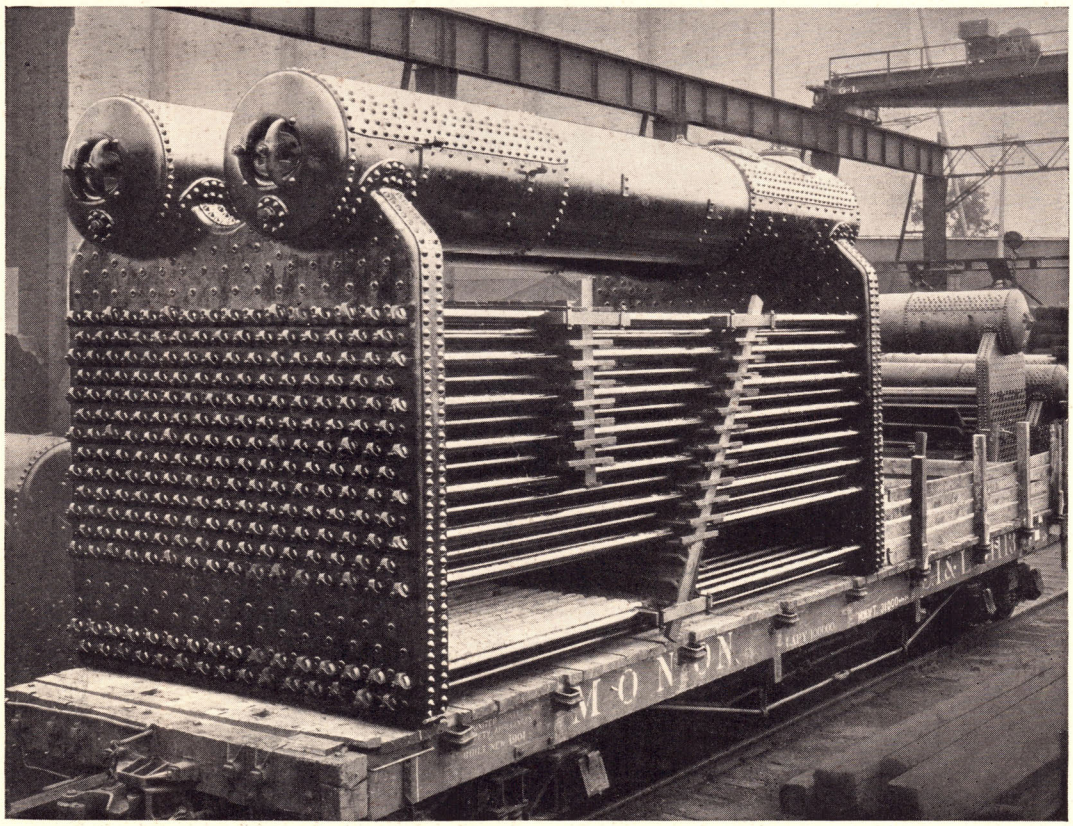

Fig. 19—One of four 421 hp. Heine HC-type Boilers ready for shipment to a large coal mining company in Illinois. Note the "REFRACTITE" baffles were put into the boiler in the shop before loading.

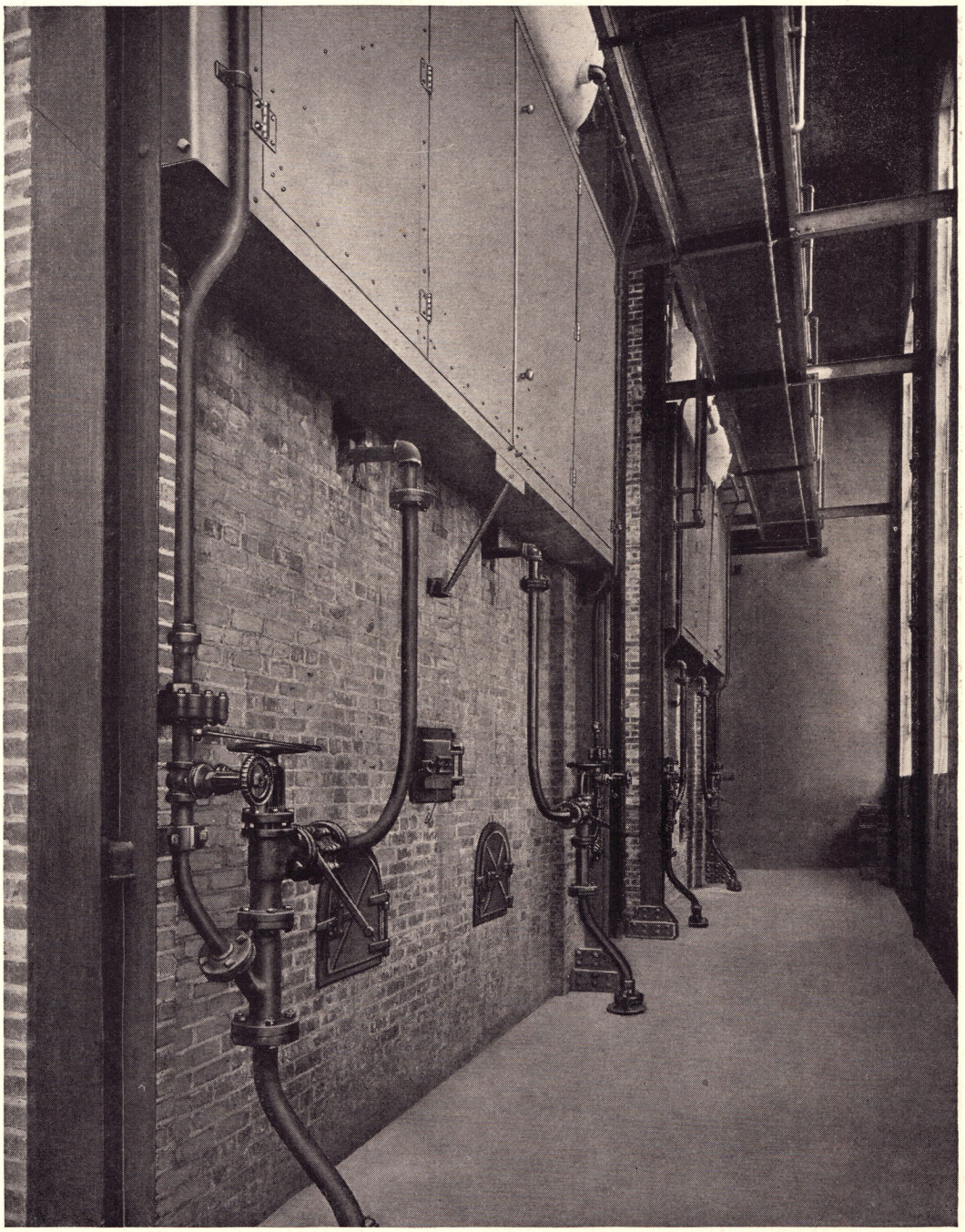

Fig. 20—Hinged type of rear casing doors and casing on two 750 hp. Heine H-type Boilers.

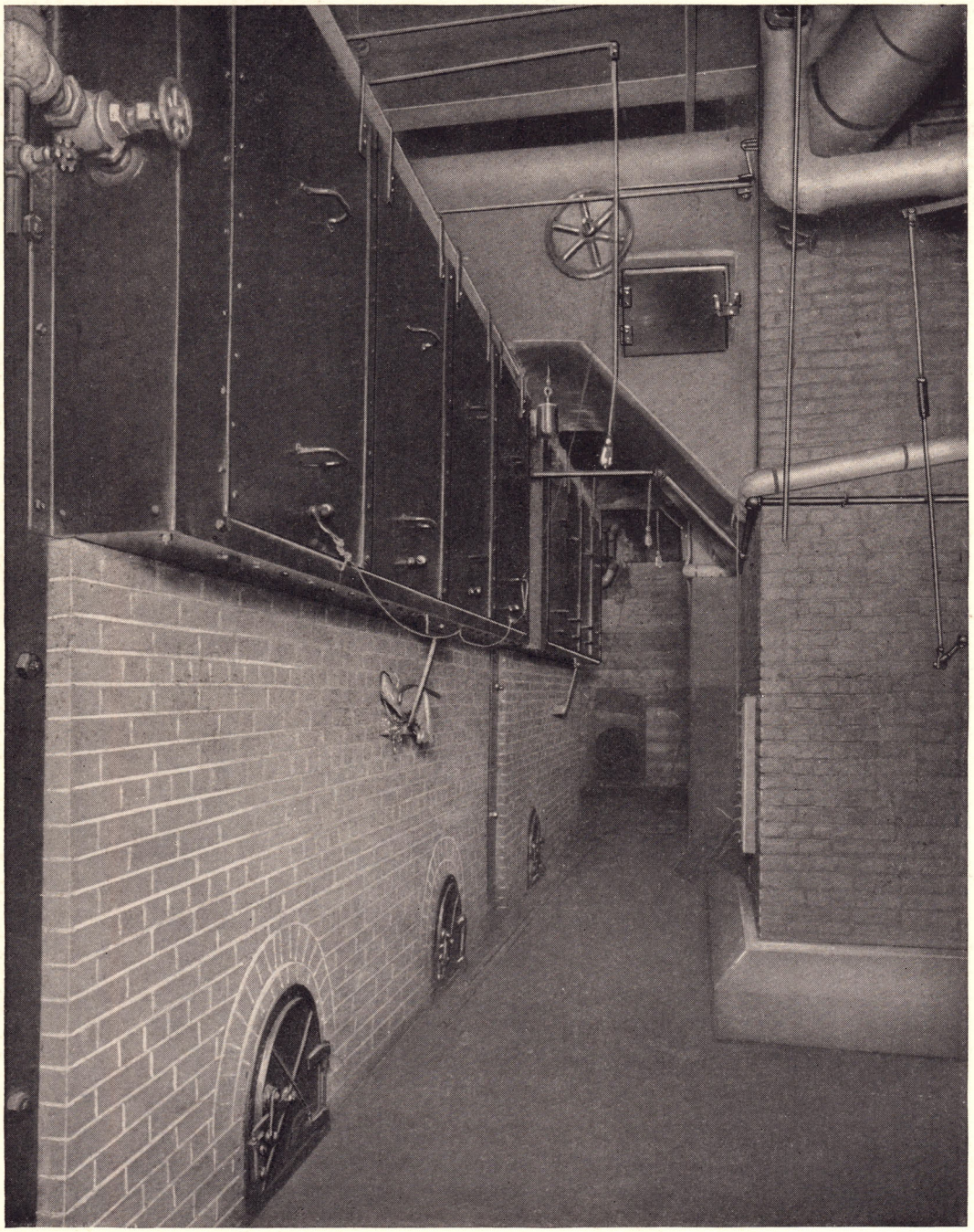

Fig. 21—Typical rear casing and overhead suspension type doors as used on the larger sizes of long-drum boilers.

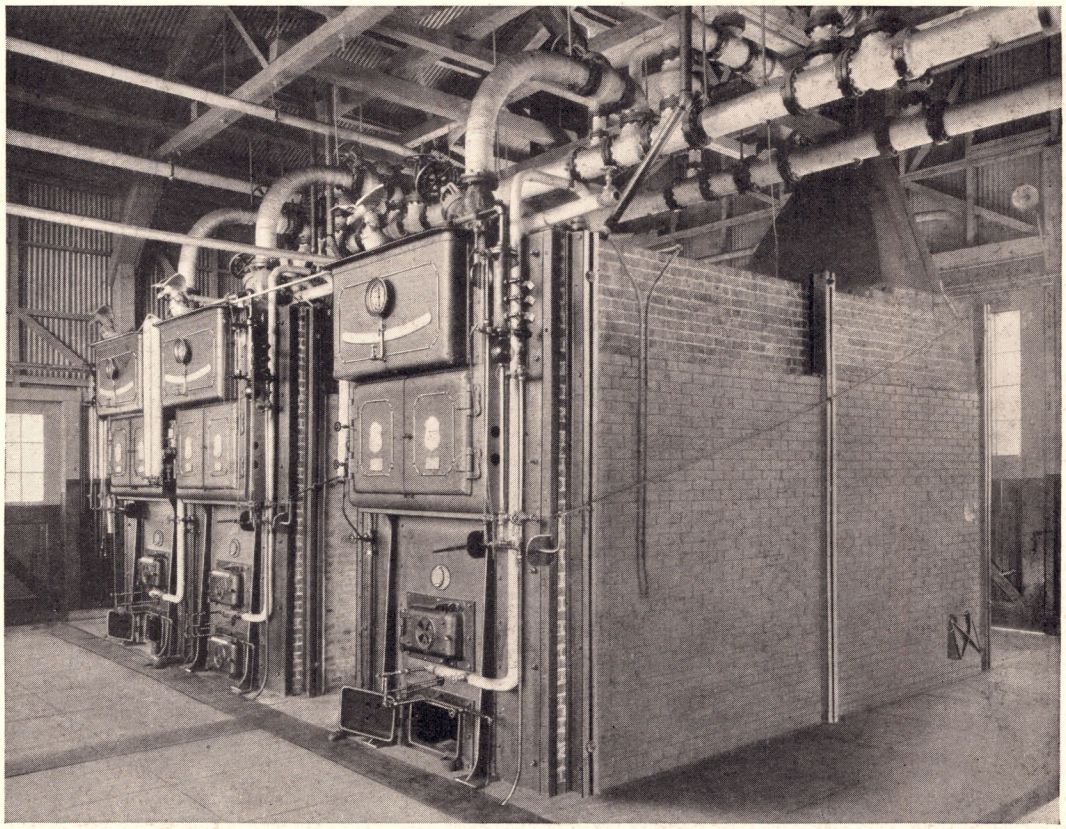

Fig. 22—An installation of three small oil-burning Heine H-type Boilers in the shops of a large western railroad.

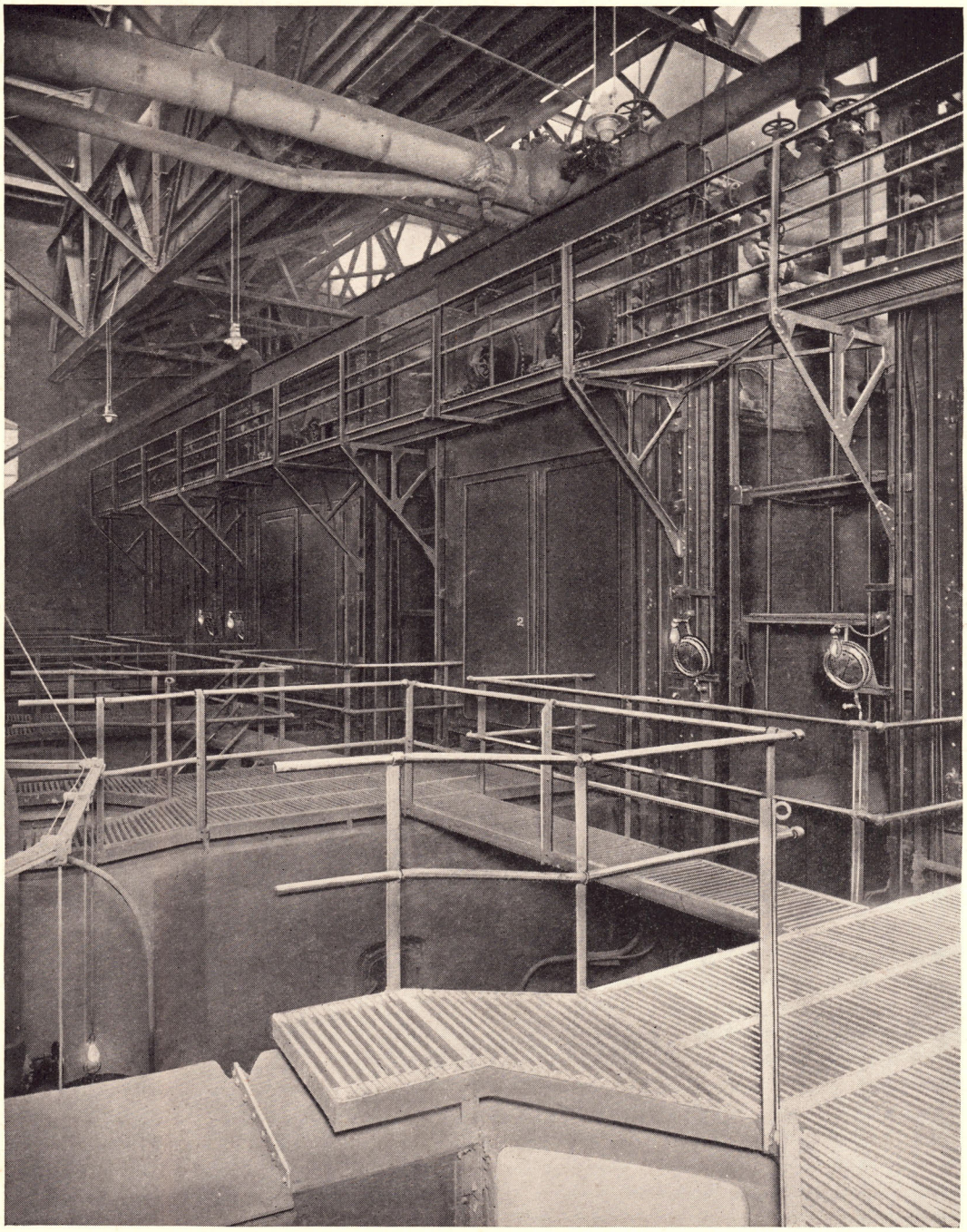

Fig. 23—Four 860 hp. Heine Long-Drum waste heat boilers in a cement manufacturing plant.

Cleaning Boilers

ALL Heine Long-Drum Boilers can be cleaned internally with a minimum expenditure of time and energy since each tube is accessible through its corresponding handhole. Every tube may be inspected and cleaned from the outside of the boiler at either end, whichever is more convenient. The manhole gives access to the interior of the drum for inspection of, and attention to, the several internal appliances. There is no part of the inside of the boiler which cannot be thoroughly inspected by direct vision and reached with tools for properly cleaning the various surfaces.

All H-type boilers may be provided with a steam soot-blowing system which is applied to the hollow staybolts. This system enables the external surfaces to be cleaned of accumulations of soot and dust by merely opening a series of valves at stated intervals. No openings are needed in the side walls for any cleaning operations.

Any of the well known rotating steam jet blowers may be installed in the HC-type boilers. The front and rear passes may also be cleaned by means of a steam hand lance placed through the hollow staybolts, the middle pass being cleaned from the side by a hand lance introduced between the rows of tubes through openings in the side wall provided for this purpose. The front and rear passes may also be cleaned in this way if desired.

It will thus be seen that both Heine H-type and Heine HC-type boilers may be thoroughly, satisfactorily and easily cleaned both internally and externally, thereby enabling them to be kept in the most efficient condition for economical operation, with a minimum expenditure of time and labor.

SIZES AND PRESSURES

BOILERS of the H and HC types can be built in units of from 100 hp. to 1200 hp. and for pressures up to 500 lb. per sq. in.

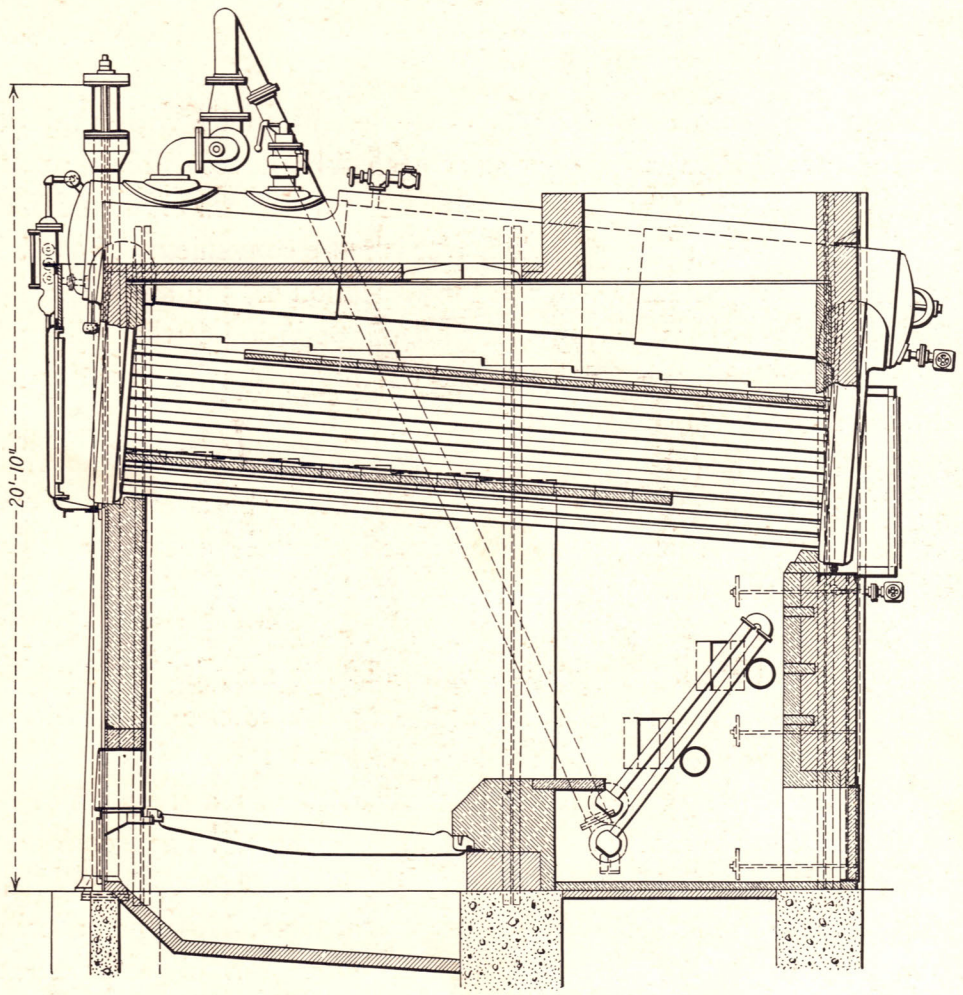

Fig. 24—A 357 hp. two-baffle Heine H-type Boiler with hand fired furnace and superheater back of the bridge wall.

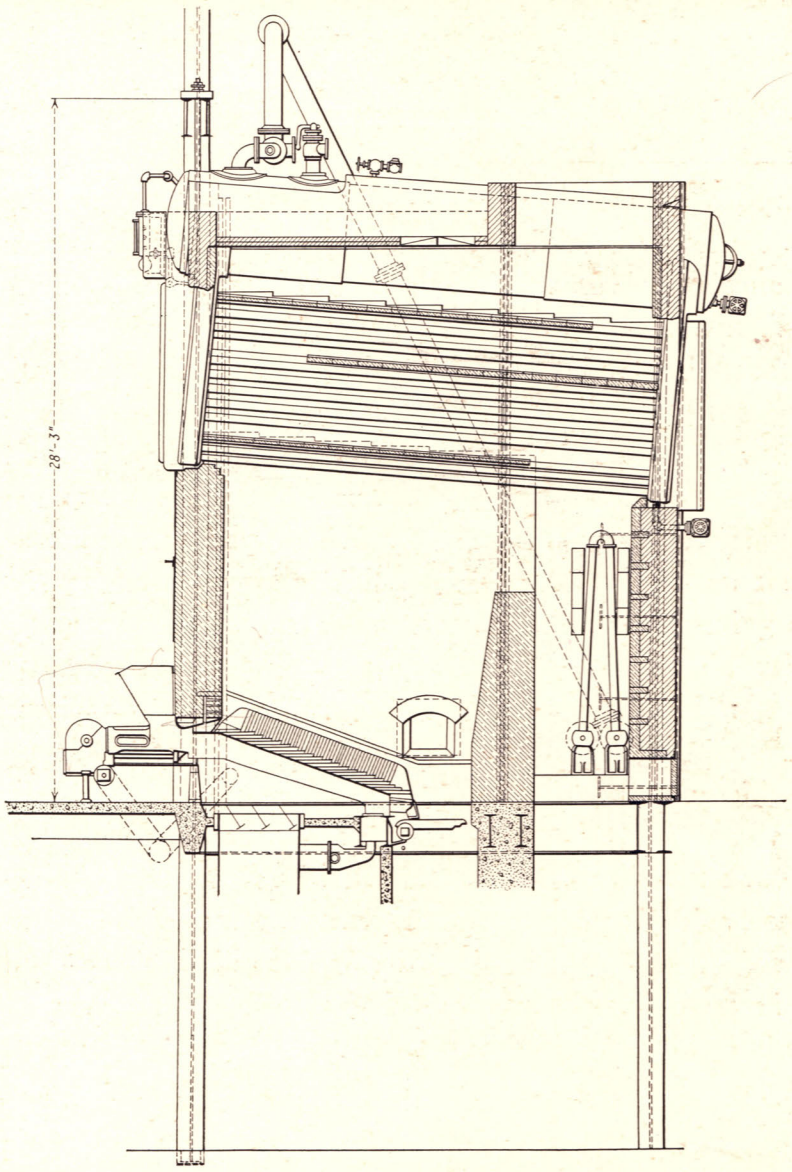

Fig. 25—Heine H-type 750 hp. Boiler with three baffles and superheater against rear furnace wall. This is one of several boilers in an electric power station.

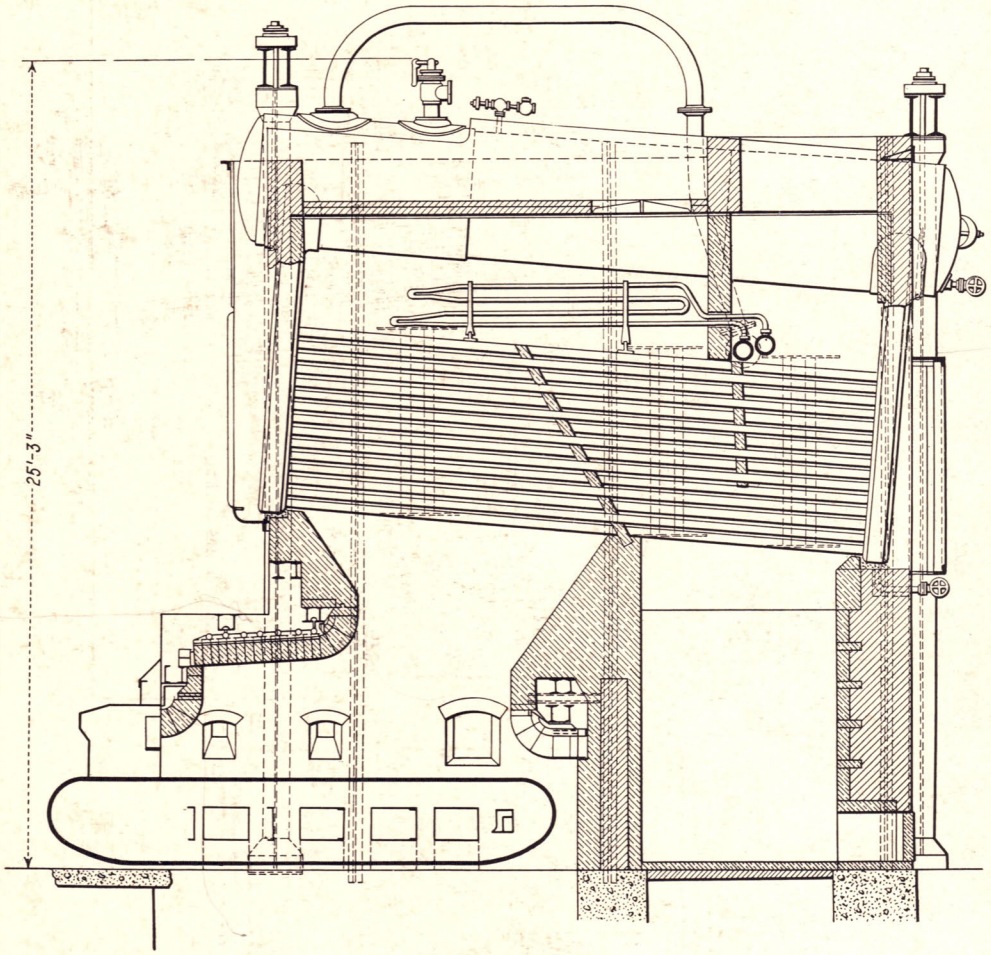

Fig. 26—Heine HC-type Boiler with superheater above the tube bank. This is one of many Heine-built boilers installed in the plants of a large water-works operating company.

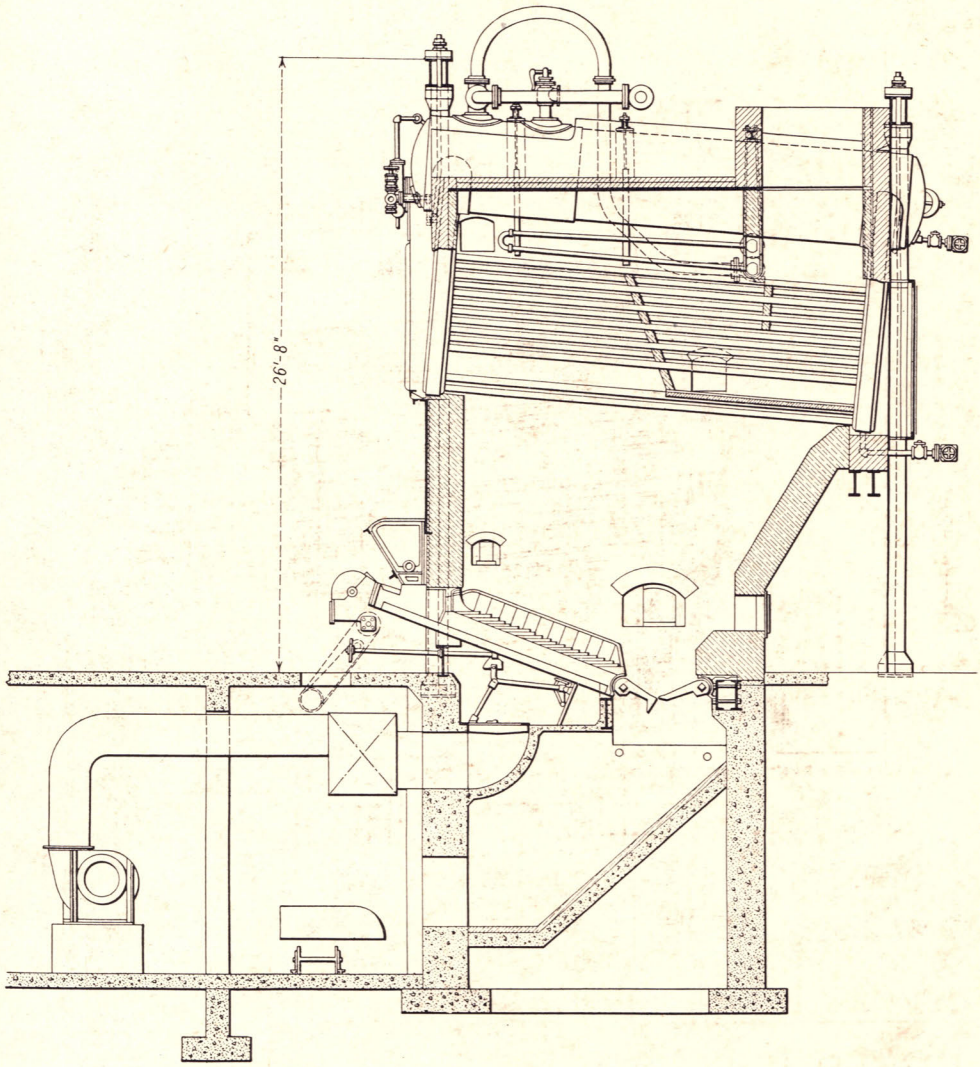

Fig. 27—Heine HC-type Boiler with combination horizontal and cross baffling, equipped with superheater above the tube bank.

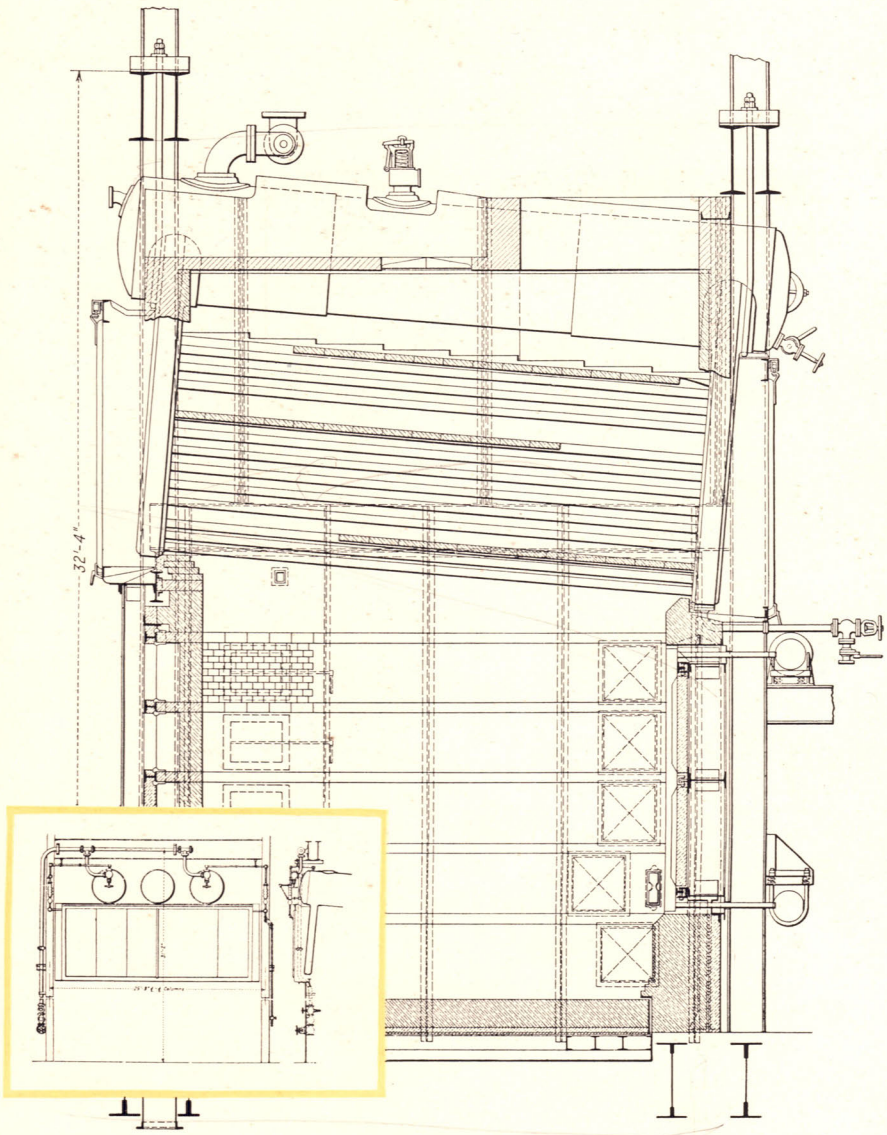

Fig. 28—Heine 1200 hp. H-type Boiler oil-burning furnace and radiant heat type superheater. This is one of five H-type boilers installed in a New England electric power station.

Heine Boiler Company

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Printed in U. S. A.